CLAIMS

1. A green ceramic coating composition comprising nano-sized particles dispersed within a carrier medium together with pre-formed particles.

2. A coating composition according to claim 1, wherein the nano-sized particles are less than 200nm in size.

3. A coating composition according to claim 2, wherein the nano-sized particles are less than 100 nm in size.

4. A coating composition according to claim 3, wherein the nano-sized particles have a particle size distribution in the range from 10nm to 100nm.

5. A coating composition according to any one of the preceding claim, wherein the carrier medium is selected from water or a polar organic carrier medium.

6. A coating composition according to any one of the preceding claims, wherein the pre-formed particles have a crystalline nano-structure

7. A coating composition according to any one of the preceding claim, wherein the pre-formed particles have a particle size ranging from 5μm to 300 μm

8. A coating composition according to claim 7, wherein the pre-formed particles have a particle size ranging from 10μm to 150μm.

9. A coating composition according to any one of the preceding claims, wherein the pre-formed particles form a framework such that at least some of the pre-formed particles contact each other.

10. A coating composition according to any one of the preceding claim, wherein the pre-formed particles are prepared from a ceramic material selected from any of the following either alone or in combination oxides, borides, silicides, phosphates, sulfides of any of the following boron, aluminium, silicon, titanium, zirconium, hafnium, vanadium, niobium, tantalum, chromium, molybdenum, tungsten, lanthanum, yttrium, iron, cobalt and nickel.

11. A method for producing a ceramic coating upon a substrate comprising the following steps: preparing a nano-suspension comprising nano-sized ceramic particles, preparing pre-formed particles, concentrating the nano-suspension to form a nano-slurry, mixing the preformed particles with the nano-slurry, applying the aforesaid mixture to the substrate, and heat treating the system such that the aforesaid particles produce a ceramic coating.

12. A method according to claim 11, wherein the ratio of pre-formed particles to nano-sized particles is in a range from 1:5 to 1:1 on a dry weight basis.

13. A method according to claim 12, wherein the ratio of pre-formed particles to nano-sized particles is 2:5.

14. A method according to any of claims 11 to 13, wherein the nano-slurry has a solid loading of from 20 to 60 wt%.

15. A method according to any of claims 11 to 14 wherein the nano-slurry is in the form of a paste.

16. A method according to any of claims 11 to 15, wherein the paste comprises any of the following additional ingredients either alone or in combination: water, at least one polar dispersing medium and at least one polymeric surfactant.

17. A method according to claim 16, wherein the polymeric surfactant is selected from polymethacrylic acid (PMAA), poly-methacrylate (PMMA), polyvinyl alcohol and methyl cellulose.

18. A method according to claim 16 or claim 17, wherein the polymeric surfactant constitutes upto about 5% w/w.

19. A method according to any of claims 11 to 18, wherein the coating afforded has a thermal conductivity below 1.0 w/m°C.

20. A method according to any of claims 11 to 19, wherein the coating afforded comprises stable zirconia phases.

21. A method according to any of claims 11 to 20, wherein the green coating is heated at any temperature in the range from 300 to 1200°C.

22. A method according to any of claims 11 to 21, wherein following heat treatment the ceramic coating is infiltrated with an infiltration suspension or slurry.

23. A method according to claim 22, wherein the infiltration process takes place in a pressure chamber at a pressure greater than 1MPa.

24. A method according to claim 22 or claim 23, wherein the infiltration suspension or slurry exclusively comprises nano-sized particles.

25. A method according to claim 22 or claim 23, wherein the infiltration suspension or slurry comprises a mixture of nano-particles and conventional fine powders.

26. A method according to any one of claims 11 to 25 wherein the infiltration media is selected from any of the following either alone or in combination: molten metals, molten salts, metallic particles dispersed within a carrier medium, polymeric materials and inorganic binders.

27. A green composite coating material comprising pre-formed particles dispersed within a carrier medium together with an infiltration media and/or nano-sized particles.

28. A method for producing a composite coating upon a substrate comprising the steps of: preparing pre-formed particles, preparing an infiltration medium, mixing together said particles and said medium, optionally adding to the mixture a nano-slurry or suspension, applying the aforesaid mixture to the substrate, and heat treating the system such that the aforesaid particles become sintered/set thus producing a composite coating.

29. A method of infiltrating a composite coating comprising the steps of: preparing a substrate having a composite coating as referred to in claim 2, applying to the said coating an infiltration medium and/or nano-suspension/slurry, and heat treating the aforesaid infiltrated coating.

30. A method according to any of claims 22 to 29, wherein the infiltration media has a solid loading in the range from 5 to 80wt%.

31. A method according to any one of claims 22 to 30, wherein following infiltration the coating is dried and heat treated at a temperature in the range from 300 to 1200°C.

32. According to a further aspect of the present invention there is provided a method for producing a ceramic/metal composite coating upon a substrate comprising the steps of: preparing pre-formed particles, preparing a nano-slurry, mixing together

said particles and said slurry, applying the aforesaid mixture to the substrate, and heat treating the system to produce a partially sintered ceramic porous coating; filling the pores and voids in aforesaid ceramic porous coating by employing electrochemical plating and/or electroless deposition with metallic materials, thus forming a ceramic/metal composite coating.

33. A method according to claim 32, wherein the metallic materials are selected from any of the following either alone or in combination: a pure metal such as iron, cobalt, nickel, molybdenum, tungsten, lanthanum, uttrium, vanadium, mobium, tantalum, chromium, boron, aluminium, silicone, titanium, zirconium, hafnium or an alloy thereof.